Bioremediation of Explosives

Scientists at INL have experience in the bioremediation of explosives including vadose zone soils at historical explosives testing areas and training ranges, liquid streams from industrial processes and groundwater remediation. The expertise begins with the site characterization and remediation of explosives testing areas and training ranges, where remediation is confounded by the presence of particulates and larger chunks of the explosives.

A number of biotreatment strategies and systems for remediating explosives-contaminated soils have previously been proven effective on screened soils or soils devoid of sizeable explosive particles. In contrast, solid explosive chunks within a soil matrix such as those present at INL, constitute a major problem in the bioremediation of a contaminated site. Complete biodegradation of a solid chunk of TNT in soil is difficult to achieve because little of the contaminant is available to microorganisms which degrade it (TNT is soluble in water at 100 to 200 µg/mL). A pretreatment which renders the soil/chunk explosive matrix amenable to conventional biotreatment technologies has been developed at INL. We are currently refining the systems necessary for integrating the physical/chemical pretreatment with the appropriate modifications of proven biotreatment technologies such as composts or

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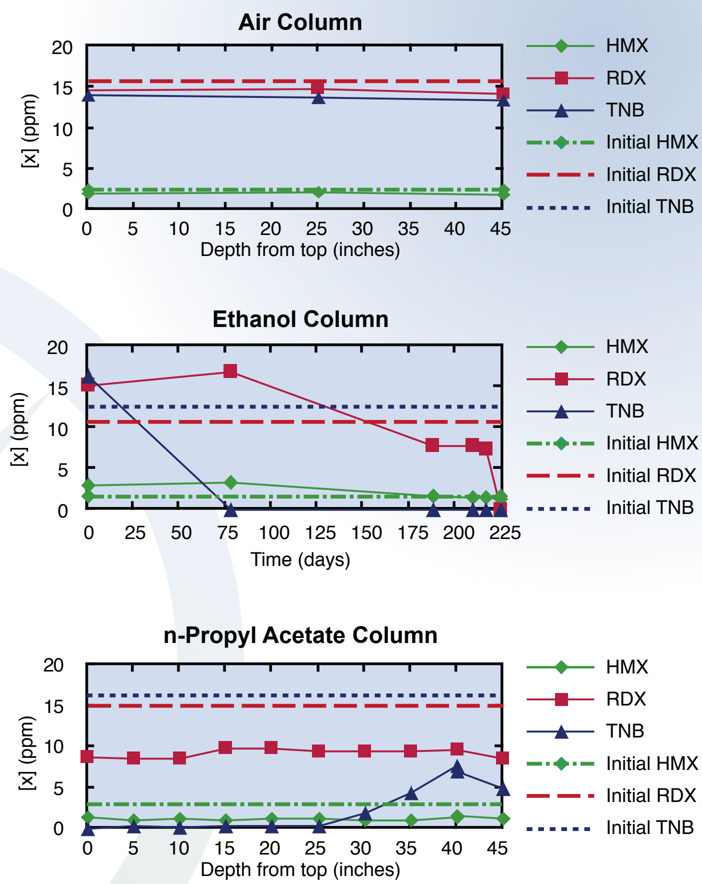

Columns contained contaminated soil from the Department of Energy Pantex facility and received gas-phase remediation treatments over time. After 225 days of continuous down flow of gases, the columns were sectioned and the soil explosives quantified. The gas flowed downward at a linear velocity of 1 cm/min, the same as the average flow rate estimated in the field site.

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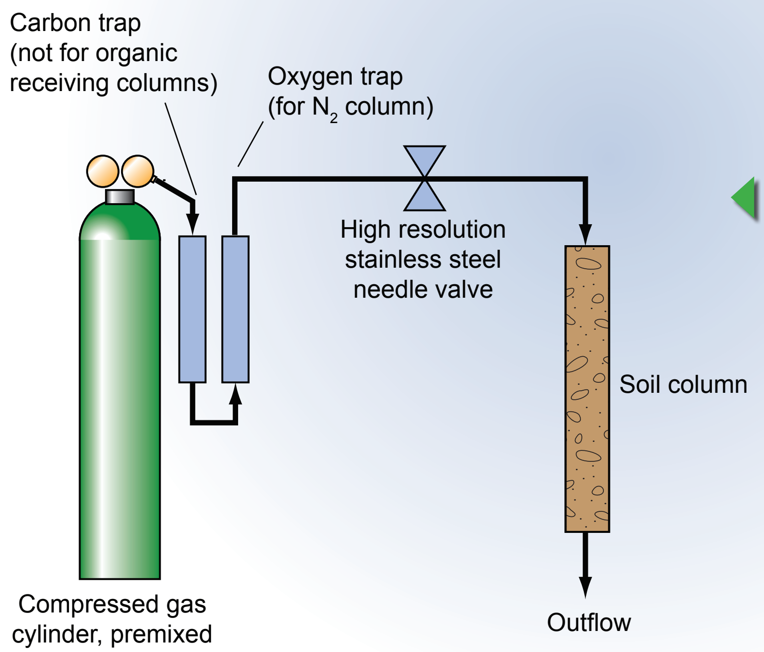
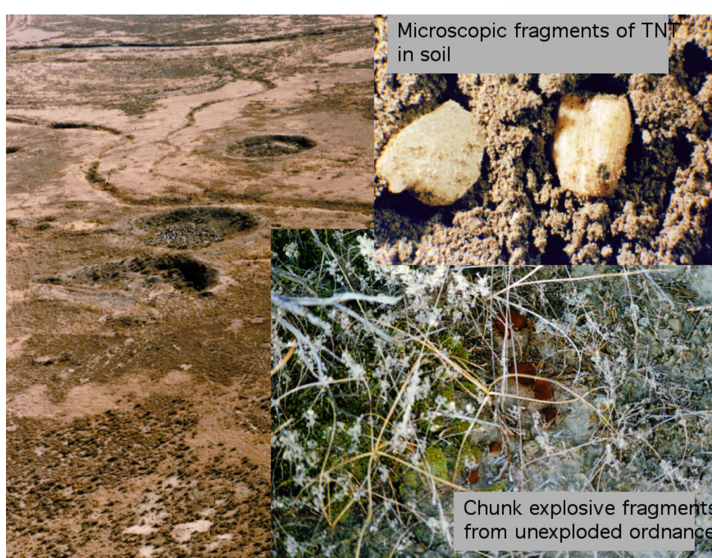
soil bioslurries. Because the degradation of explosives has been shown to be dependent on a variety of environmental criteria including redox potential, pH, available electron acceptors and electron donors, site-specific testing continues to be a necessary first investigative step toward remediation of a particular facility.

Explosives in aqueous waste streams

We have also developed an immobilized cell bioreactor system capable of degrading 2,4,6-trinitrophenol (picric acid) in an aqueous waste stream. The reactor uses a degradation pathway in which picric acid (as picrate) is the main carbon and energy source. The resulting system degrades picrate completely, as evidenced by stoichiometric nitrate release. After a series of reactor optimizations, the process handles up to 4,000 µg/mL picrate with a residence time of 1.5 days. The system is currently being scaled up for application at a small remote hazardous waste site.



Schematic of the treatment system use for the laboratory studies.



For more information

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